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DISCUSSION OF "SUMMARIES OF PRE-CAMBRIAN
LITERATURE OF NORTH AMERICA," BY
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The recent "Summaries of Pre-Cambrian Literature of North America" by Professor Edward Steidtmann¹ bring up points to which certain contributions and corrections should be made. He states that,

(1) . . . the pre-Cambrian rocks northeast of Lake Huron show one conspicuous unconformity, and above the conspicuous unconformity are two series of slightly metamorphosed, dominantly clastic sediments, separated by an inconspicuous unconformity. (2) The lower one, the Bruce series, locally contains tillites. The upper series is generally known as the Cobalt series. (3) At Killarney, on the north shore of Lake Huron, Collins has found that the Bruce and possibly the Cobalt series are intruded by Killarney granite, and in this locality they assume many of the characteristics of the older series, the Timiskaming.²

In regard to the so-called "inconspicuous unconformity," Steidtmann followed Coleman (1915)³ and Miller and Knight (1915).⁴ Later work by Collins⁵ shows that in the region southeast of McCabe Lake, north of Cutler, erosion removed the Serpent quartzite, the Española group, the Bruce conglomerate, and part of the Mississagi formation, amounting to the greater part of the Bruce series, previous to deposition of the Cobalt series. In 1914 he showed that the erosion interval amounted to thousands of

¹ *Jour. Geol.*, Vol. XXVIII (1920), pp. 643-58.

² *Ibid.*, p. 643. The numbers have been inserted by the writer.

³ A. P. Coleman, *Problems of American Geology*, pp. 81-161. Quoted by Edward Steidtmann, *op. cit.*, p. 647.

⁴ W. G. Miller and C. W. Knight, *Jour. Geol.*, Vol. XXIII (1915), pp. 585-99. Quoted by Edward Steidtmann, *op. cit.*, p. 656.

⁵ W. H. Collins, report in preparation.

feet over large areas.¹ And in the Española² area there is a probable difference of erosion of more than 5,000 feet within 10 miles. It is largely a matter of opinion as to how important such an unconformity should be considered, but it is surely not inconspicuous. Erosion intervals of thousands of feet in Paleozoic series are considered notable, and they should not be undervalued in pre-Cambrian series. However, in fairness to all it must be added that there are places where the unconformity appears to be slight; generally only by tracing it over large areas, as Collins has done, can the observer recognize its true greatness. Furthermore, in comparison with the great unconformities beneath and above the Huronian formations the Bruce-Cobalt unconformity is much less conspicuous. This at least may be said, the unconformity locally is inconspicuous but nevertheless important.

Second, in saying that the Bruce series, the lower Huronian series of Ontario, locally contains tillites, Steidtmann appears to follow Coleman (1915).³ The fact is that the tillites are characteristic only of the upper group, the Cobalt series, or specifically the Gowganda formation of Collins.⁴ The glacial origin of at least part of the Cobalt conglomerate is held by Wilson (1913),⁵ Collins (1914),⁶ and by Coleman himself first (1907)⁷ and last (1920).⁸ The Bruce conglomerates in certain phases are distinctly different in character from the Cobalt tillite. They lack the thinly laminated slates and the well-bedded slate layers carrying scattered

¹ W. H. Collins, *Canada Geol. Survey, Museum Bull. No. 8* (1914), p. 21.

² T. T. Quirke, *Canada Geol. Survey, Mem. No. 102* (1917), p. 42. Apparently through errors in copying, the summary of Quirke's classification on p. 657 of Steidtmann's paper differs considerably from the work summarized, both by omissions and by faulty arrangement. See *Canada Geol. Survey, Mem. No. 102*, pp. 6 and 7.

³ Quoted by Steidtmann, *op. cit.*, pp. 646, 648.

⁴ W. H. Collins, *Canada Geol. Survey, Mem. No. 95* (1917), p. 10.

⁵ Morley E. Wilson, *Jour. Geol.*, Vol. XXI (1913), pp. 121-41, and *Canada Geol. Survey, Mem. No. 17* (1912). Quoted by Steidtmann, *op. cit.*, p. 658.

⁶ W. H. Collins, *Congrès géologique international*, XIIth Session (1914), pp. 399-407. Quoted by Steidtmann, *op. cit.*, p. 650.

⁷ A. P. Coleman, *Am. Jour. Sci.*, Vol. XXIII (1907), pp. 187-92; *Jour. Geol.*, Vol. XVI (1908), pp. 149-58; *Bull. Geol. Soc. Am.*, Vol. XIX (1908), pp. 347-66.

⁸ A. P. Coleman, *Economic Geology*, Vol. XV (1920), No. 6, pp. 539-41.

pebbles and boulders. They have little argillaceous matrix about the inclusions in massive conglomerates. They are not "slate" conglomerates, as part of the Gowganda formation is. Their character is essentially that of a basal or alluvial deposit. In part they are well sorted and in part they are massive, but the massive material is composed characteristically of dark-colored graywacke, or of gritty or bowldery conglomerate. In no instance is there record of striated, glacially soled boulders being found in Bruce conglomerates. Nowhere to our present knowledge is there a polished basement beneath them. The matrix of the Bruce conglomerates is commonly dark-colored, arkosic, and graywacke-like; the matrix of typical Cobalt tillite is green, pale-green on weathered surfaces, and looks like metamorphosed clay. So clear is the difference in the character of certain phases of the matrices that members of Collins' parties from 1914 to 1918, with some practice, were able to tell from a glance at typical hand specimens whether or not the rock was Bruce or Cobalt conglomerate. This difference in the character of the matrix is a genetic difference, connected with the glacial origin of the one and the non-glacial origin of the other. Those phases of the Bruce conglomerate which are very similar to the less characteristic phases of the Cobalt conglomerate conceivably may be of an obscure, glacial origin.

It is not altogether surprising that a reviewer of the literature should fall into confusion. Originally, in accordance with the best nomenclature of the day, Coleman¹ referred to the Cobalt conglomerate as Lower Huronian, as is quite clear from his writings in 1907 and 1908; whereas the only locality of distinctly glacial deposits he cited is the Cobalt silver-producing district which is underlain by the upper, Cobalt series, not by the Bruce conglomerate now known as the lower series. Furthermore, Coleman, himself, at one time seems to have been confused by the similarities between the Bruce and the Cobalt conglomerates. Indeed Professor Willmott² previously (1901) had written: "The two slate

¹ A. P. Coleman, "The Lower Huronian Ice Age," *Jour. Geol.*, Vol. XVI (1908), p. 149; *Bull. Geol. Soc. Am.*, Vol. XIX (1908), p. 355; *Am. Jour. Sci.*, Ser. 4, Vol. XXIII (1907), pp. 190-91.

² A. B. Willmott, *American Geologist*, Vol. XXVIII (1901), p. 19.

conglomerates of Murray are so much alike that they cannot be distinguished. Where the limestone band is absent, as it often is, they join, and Murray himself confesses that he could not draw the dividing line." Nevertheless, in some such places the dividing line may be, and has been, drawn. On the other hand, there are phases of the Bruce conglomerate so similar in character to phases of the Cobalt conglomerate that no distinctions have yet been recognized. Another factor which may have caused confusion in the reports of Coleman is the fact that he found at Cobalt the Cobalt conglomerate to be the basal conglomerate of the Huronian formations, the entire Bruce series being wanting. Thus, carrying his correlations westward from Cobalt, he supposed the basal conglomerate of the original Huronian area to be the same as that at Cobalt, whereas it is actually the base of the Mississagi formation of the Bruce series. However, all this was clearly put straight by Collins¹ in 1916, and it seems a pity to have confusion again after the known facts have been published. So far as is now known, the Bruce conglomerates, certainly for the main part, are not of glacial origin, but some of the Cobalt conglomerates are agreed to be tillites.

Regarding the last topic, the work of the writer carried on this summer near Lake Geneva, 20 miles northwest of Sudbury, Ontario, shows that syenitic masses intrude the Cobalt series, thus confirming and complementing the work of Collins (1916)² on the age of the Killarney granite. Collins found that the Bruce series certainly and possibly the Cobalt formations, are intruded by an acid intrusive in an area north of Lake Huron, from 15 to 25 miles southward from Sudbury. Now it is known that what might have been considered a local phenomenon of little consequence in pre-Cambrian classification and correlation must be regarded as probably a widespread and considerable intrusion. The age of these intrusions having been determined and confirmed in areas 40 miles apart, it becomes necessary to scrutinize carefully those local correlations and distinctions which are based largely upon different periods of orogenic movement and acid intrusions. Almost certainly it will

¹ W. H. Collins, *Canada Geol. Survey, Mus. Bull. No. 8* (1916).

² *Ibid.* No. 22 (Feb. 5, 1916). Quoted by Steidtmann, *op. cit.*, p. 650.

be recognized, as it has been found already, that some masses of supposedly pre-Huronian and Sudburian rocks will be identified as Huronian sediments intruded by these late pre-Cambrian granites and syenites. However, there are surely some areas which are not subject to such a revision, in which the reality of the pre-Huronian sediments seems to be beyond dispute; so that we may bring our ideas of the pre-Cambrian succession of events north of Georgian Bay more up to date, as follows (the events being listed in chronological order from the bottom up):

SEQUENCE OF PRE-CAMBRIAN EVENTS IN THE TIMISKAMING REGION

Proterozoic Era

Intrusions of Killarney and Geneva granites and syenites, accompanied by severe faulting, mountain folding, and extensive warping.

Injections and extrusions of basic rocks (Keweenawan)

Deposition of Whitewater series

Chelmsford sandstone

Onwatin slate

Onaping tuff

Trout Lake conglomerate (not tillite)

Hiatus, relations unknown

Deposition of Cobalt series

White quartzite

Cherty quartzite

Lorrain quartzite and conglomerate (not tillite)

Gowganda formation—including tillites

Considerable interval of erosion, the resulting sediments being unknown

Deposition of Bruce series

Serpent quartzite and conglomerate (not tillite)

Española limestone

Española graywacke

Bruce limestone

Bruce conglomerate (probably not tillite)

Mississagi quartzite and basal conglomerate (not tillite)

Great interval of erosion, the resulting sediments being unknown

Archeozoic Eras

Time of orogenic diastrophism accompanied by acid intrusions (Algoman)

Deposition of pre-Huronian sediments (Sudburian and others), quartzites, graywackes, conglomerates

Great interval of erosion, the resulting sediments being generally unknown, but represented in part by Sudburian and other pre-Huronian sediments
Time of granite intrusions and diastrophism (Laurentian—all inferred from the presence of granite boulders in pre-Huronian conglomerates)
Deposition of products of Keewatin weathering, accompanied and interrupted by volcanic extrusions and intrusions of undetermined order and distribution

NOTE:—The above communication has been made with the permission of the Director of the Geological Survey of Canada.